Coatings cohesion strength determn. - by bending even number of identical samples with coplanar coating - base interfaces and symmetrical bases on both sides

Abstract (Basic): SU 714221 A

Increased accuracy of determining coatings cohesion strength is attained by subjecting the even number of samples simultaneously to bending moments. The identical samples with coating (5-8) on bases (1-4) are bolted in test machine in such a manner that coating base interface is coplanar (0-0) and bases arranged symmetrically on both sides of the plane making total cross section on both sides identical. The samples are then subjected to pure bending moments.

The arrangement ensures neutral bending plane coincidence with coating base interface, thus practically avoiding stress forces affecting the cohesion strength.

?

Союз Советских Социалистических Республик

Государственный комитет СССР по делам изобретений и открытий

ОПИСАНИЕ ИЗОБРЕТЕНИЯ

К АВТОРСКОМУ СВИДЕТЕЛЬСТВУ

(11) 714221

(61) Дополнительное к авт. свид-ву –

(22) Заявлено 14.12.76 (21) 2429022/25-28

с присоединением заявки № –

(23) Приоритет –

Опубликовано 05.02.80. Бюллетень № 5

Дата опубликования описания 08.02.80.

(51) М. Кл.[2] G 01 N 3/20

(53) УДК 620.174.2 (088.8)

(72) Авторы изобретения Л. А. Ярошевская и И. Г. Шерман

(71) Заявитель Научно-исследовательский и конструкторско-технологический институт эмалированного химического оборудования

(54) СПОСОБ ОПРЕДЕЛЕНИЯ КОГЕЗИОННОЙ ПРОЧНОСТИ ПОКРЫТИЙ

1

Изобретение относится к испытаниям материалов, в частности к способам определения когезионной прочности покрытий.

Наиболее близким по технической сущности и достигаемому результату к изобретению является способ определения когезионной прочности покрытий, заключающийся в том, что образцы в виде основы с нанесенным на нее покрытием закрепляют в зажимах испытательного устройства, нагружают изгибом, фиксируют момент появления трещин в покрытиях и судят о прочности покрытий по величине их деформаций [1].

Недостатком известного способа является его низкая точность, поскольку на процесс зарождения трещин влияет текучесть металла основы на границе раздела покрытие–основа..

Цель изобретения – повышение точности способа.

Указанная цель достигается тем, что одновременно подвергают изгибу четное количество одинаковых образцов, размещенных таким образом, что поверхности раздела покрытие–основа всех образцов лежат в одной плоскости, причем основы образцов располагают по разные стороны от этой плоскости так, что суммарные площади их сечений по обе стороны плоскости одинаковы.

2

На фиг. 1 изображена схема нагружения образцов; на фиг. 2 – разрез А–А фиг. 1; на фиг. 3 – разрез Б–Б фиг. 1.

Предложенный способ осуществляется следующим образом.

Образцы в виде основ 1–4 (образцов может быть любое четное количество) с нанесенным на них в рабочей части покрытием 5–8 закрепляют в зажимах 9 и 10 с гнездами для установки образцов таким образом, что поверхности раздела покрытие–основа всех образцов лежат в одной плоскости 00', причем основы образцов располагают по разные стороны этой плоскости так, что суммарные площади их сечений по обе стороны плоскости одинаковы, т.е. суммар-

ная площадь сечений основ 1 и 2 равна суммарной площади сечений основ 3 и 4. Нагружение образцов по схеме чистого изгиба проводят, размещая зажимы 9 и 10 на двух опорных призмах 11 и 12 и передавая нагрузку через нажимные призмы 13 и 14. Образцы зажимаются в гнездах зажимов болтами 15, с целью исключения их осевых перемещений.

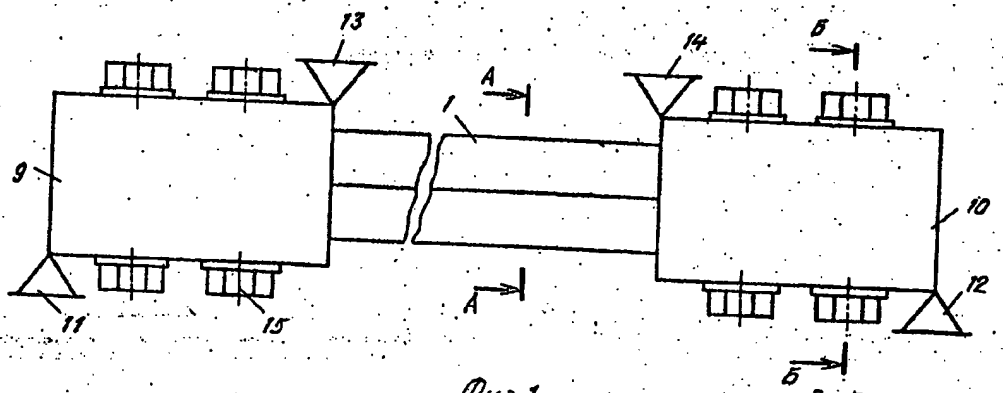
Предложенный способ позволяет при испытании обеспечить совпадение нейтральной линии изгиба с плоскостью раздела покрытие–основа, поэтому материал основы в плоскости раздела практически не нагружен и его деформации не влияют на когезионную прочность покрытий, которая может быть определена с высокой точностью.

Формула изобретения

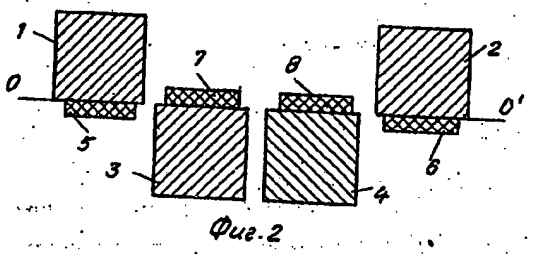
Способ определения когезионной прочности покрытий, заключающийся в том, что образцы в виде основы с нанесенным на нее покрытием закрепляют в зажимах испытательного устройства, нагружают изгибом, фиксируют момент появления трещин в покрытиях и судят о прочности покрытий по величине их деформаций, отличающийся тем, что, с целью повышения точности определения, одновременно подвергают изгибу четное количество одинаковых образцов, размещенных таким образом, что поверхности раздела покрытие–основа всех образцов лежат в одной плоскости, причем основы образцов располагают по разные стороны от этой плоскости так, что суммарные площади их сечений по обе стороны плоскости одинаковы.

Источники информации, принятые во внимание при экспертизе

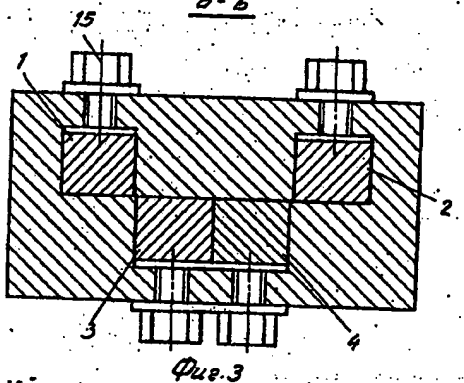
1. Ярошевская Л. А. и др. К вопросу об оценке метода составного сечения для определения упругих свойств эмалевых покрытий. – "Проблемы прочности", 1972, № 5, с. 120–123 (прототип).



Фиг.1



Фиг.2



Фиг.3

Составитель М. Кузьмин
Редактор А. Семенова Техред М. Петко Корректор М. Демчик
Заказ 9273/37 Тираж 1019 Подписное
ЦНИИПИ Государственного комитета СССР
по делам изобретений и открытий
113035, Москва, Ж–35, Раушская наб., д. 4/5
Филиал ППП "Патент", г. Ужгород, ул. Проектная, 4

Nummer: DE 197 29 438 A1
Int. Cl.[6]: G 01 N 3/02
Offenlegungstag: 11. Februar 1999

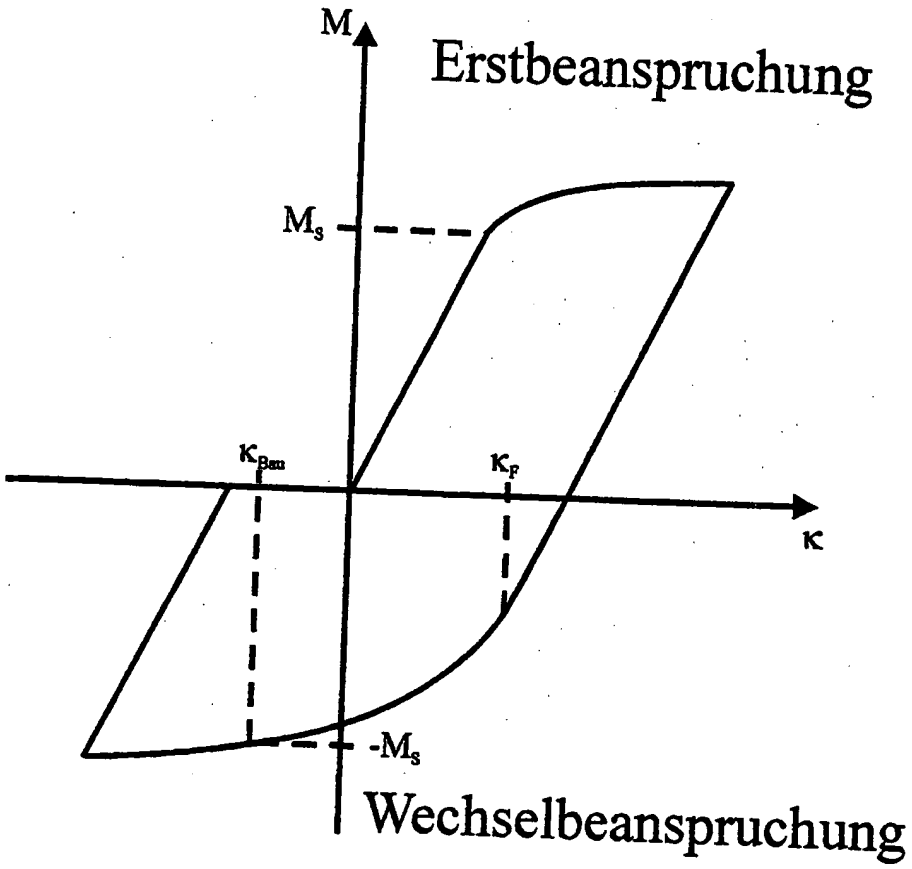


Fig. 6

PATENT SPECIFICATION

627,501

Application Date: June 20, 1946. *No. 18634/46.*

Complete Specification Left: June 20, 1947.

Complete Specification Accepted: Aug. 10, 1949.

Index at acceptance:—Class 106(ii), S1(e3:h).

PROVISIONAL SPECIFICATION

Apparatus for Fatigue Testing Specimens or Test Pieces

We, THE DE HAVILLAND AIRCRAFT COMPANY LIMITED, a British Company, of Stag Lane, Edgware, Middlesex, and RICHARD NORMAN HADWIN and JOHN ROBERT POLLARD, both British Subjects and both of the Company's address, do hereby declare the nature of this invention to be as follows:—

The invention is concerned with a device for fatigue testing specimens or test pieces by causing the specimen first to vibrate at its fundamental natural frequency, the specimen being then maintained in a state of vibration throughout the test. Such a device capable of picking up vibrations from the specimen or test piece is operatively associated with the specimen and is connected through the medium of an amplifier with an electro-magnetic exciter which in turn acts on the specimen to maintain the latter in a permanent state of vibration until the test is completed. Such a device for picking up vibrations from the specimen may comprise an electric pick-up such as, for example, a crystal, electrical strain gauge, microphone, photo-electric cell or electro-dynamic device, which is capable of either generating electric current impulses proportional to the vibrations of the specimens or is capable of passing current impulses proportional to such vibrations to the amplifier.

It has been found in the course of experiment that it is necessary to eliminate reaction at the point of mounting of such specimens or test pieces, and according to the present invention two such identical or substantially identical specimens are mounted side by side and vibrated by means of a common electro-magnetic exciter, the specimens being so mounted that the fixing moments are opposite in sign and substantially equal in magnitude. This arrangement enables the employment of a very much smaller and lighter test rig than would otherwise be necessary as the reaction transmitted to the supporting frame is extremely small.

[*Price* 2/-]

The apparatus employed for carrying the invention into effect includes a test rig, including a supporting frame on which the two identical or substantially identical specimens are clamped at one end. The two specimens are disposed in fairly close proximity and have their free ends fitted with magnetic tips. Adjacent the tips of the specimens is mounted an electro-magnetic exciter which may, for example, comprise an electro-magnetic system employing standard E and I transformer laminations. The action of the electro-magnetic exciter is to pull the tips of the specimens outwards from the centre line of the test rig simultaneously as the magnetic flux in the electro-magnetic system increases and releases the tips towards each other as the strength of the magnetic flux decreases. An electric pick-up such as has been hereinbefore referred to is associated with each specimen and the pick-ups are connected with the electro-magnetic exciter through the medium of a suitable electric amplifier. In this way on the test pieces being initially vibrated, for example by hand, so that they commence to vibrate at their natural frequency, current impulses will pass through the electric pick-up in proportion to the vibrations and these current impulses will be amplified by the electric amplifier and finally passed through the windings of the electro-magnetic exciter. In this way the system can be made to be self-driven at the fundamental natural frequency of the specimens under test and this natural frequency can be maintained at a high level, thus shortening the time required for a fatigue test.

The electric amplifier or maintaining amplifier preferably consists of a steady degenerative preamplifier, a phase-shift network, which is used to vary the phase of the regenerated signal to the value required to make the whole system regenerative and self-driving, a limiting amplifier which chops the signal to a

fixed intensity producing a square wave, a filter network which passes only the fundamental component of the square wave, and an outlet amplifier for fixed amplification which drives a power amplifier.

As hereinbefore stated, the limiting amplifier is of considerable importance as it limits the regeneration to a fixed pre-set amplitude.

It will be appreciated that if the pick-up which may, for example, be a linear vibration pick-up of the electro-magnetic or piezo-crystal type, an acoustic pick-up, for example, a microphone, or alternatively a photo-electric cell is placed in proximity to the specimen so that a signal is induced corresponding in amplitude and frequency to the vibration of each specimen. This signal can be fed through the medium of the amplifier hereinbefore referred to to the coils of the electro-magnetic regenerative system, which renders the fatigue test unit self-driving. This arrangement eliminates the need for a separate oscillator and constant readjustment as fatigue occurs in the specimens and their natural frequency falls. It is found necessary sometimes to adjust the specimens slightly in length in order to balance them in natural frequency and to ensure that they vibrate at the required amplitudes.

With the root reactions approximately equal and opposite it can be assumed with a fair degree of accuracy that no movement is taking place at the roots and thus the stresses in the specimens can be calculated from measurement of the deflected form when vibrated.

Such a method and apparatus as hereinbefore described may be used for fatigue testing many different forms of specimens or test pieces, for example, specimens or parts of propeller blades, or for testing the efficiency of various forms of bonded joints such as, for example, synthetic resin bonded metal to wood structures.

Dated this 20th day of June, 1946.

For the Applicants:
F. J. CLEVELAND AND COMPANY,
Chartered Patent Agents,
29, Southampton Buildings,
Chancery Lane, London, W.C.2.

COMPLETE SPECIFICATION.

Apparatus for Fatigue Testing Specimens or Test Pieces

We, THE DE HAVILLAND AIRCRAFT COMPANY LIMITED, a British Company, of Stag Lane, Edgware, Middlesex, and RICHARD NORMAN HADWIN and JOHN ROBERT POLLARD, both British Subjects and both of the Company's address, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to fatigue testing of specimen pieces of material and in particular to an improved apparatus for conducting the test with greater accuracy than has heretofore been possible.

It is usual when fatigue testing a specimen piece of material to maintain it in oscillation of large amplitude at one of its natural frequencies and to note any fall in the natural frequency as fatigue occurs. Such oscillations are normally maintained by means of an electric pickup device which feeds an amplifier with electrical oscillations in accordance with the vibrations of the specimen, the output of the amplifier being fed to an electromagnetic exciter which acts on the specimen to maintain it in oscillation.

In such a construction, however, the method of mounting the specimen is such that a large amount of the vibration energy is communicated to and dispersed in the mounting of the specimen, making it necessary to employ a large amplifier and a large mounting for the specimen.

It is the main object of the present invention to provide a smaller apparatus for fatigue testing than heretofore.

In accordance with the invention two substantially identical specimens of the material under test are mounted side by side and vibrated so that the vibrations are in opposite phase and the fixing moments of the specimens are opposite in direction but equal in magnitude.

It is preferred, in order to ensure that the two specimens vibrate with equal amplitude, that a single electromagnetic exciter should be used.

In order that the invention may be clearly understood, one embodiment will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a plan view of the electromagnetic exciter and specimen mountings; and

Figure 2 is a schematic diagram of the whole apparatus.

Referring more particularly to Figure 1, the electromagnetic exciter is indicated generally at 4, the specimen mounting at 5 and the electrical pick-up

device at 6, these being mounted on a base board 7. The exciter 4 is built up of standard E transformer laminations 8, the centre limb of the E being disposed closely adjacent the tips of the specimens. Two sets of I transformer laminations 9 are arranged one at the tip of each of the outer limbs so that each may attract one of the specimen tips. The laminations are held in position by normal lamination clamps which also support them on the base board. On the centre limb of the E laminations there are two coils 10, one of which is coupled to the amplifier output and the other connected to a source of direct current to polarise the exciter.

The specimens 11 and 12 are in the form of strips having enlarged ends 13 and 14 adapted to fit into the clamp 16 attached to the base. A magnetic tip 17 is attached to each specimen strip for the purpose of driving the strips. The electrical pick-up device 6 may be any vibration-sensitive device, for example a crystal, an electrical strain gauge, a microphone, a photo-electric cell or any other device which is capable of controlling or generating an electric current in proportion to the frequency of vibration of the specimens.

Referring more particularly to Figure 2, the electrical signal produced by device 6 passes directly to a degenerative amplifier indicated at A, whose function is to amplify the signal with the minimum of phase and harmonic distortion and the minimum of variation due to changes in valve characteristics or supply voltages. The amplified signal passes on from amplifier A to phase corrector B, which is a device for controlling the phase change of the amplified signal delivered to the exciter so that regeneration will occur. The signal passes from phase corrector B to amplitude limiter C, the operation of which is described with more detail in co-pending application No. 27930/48 (Serial No. 627543). The limited signal passes on to filter D for elimination of undesirable harmonics and from there to power amplifier E. The output from the power amplifier passes to a coil 10 of the exciter, a condenser F correcting the power factor so that the coil 10 is in fact tuned to the vibration frequency.

When in operation, the tips 17 of the strips are attracted towards the tips of the laminations 9 which are most closely adjacent by reason of the magnetisation produced by the polarising current passing through one of the coils 10. The output current passing through the other coil 10 varies this intensity of magnetisation at the natural frequency of the strips, thus maintaining their vibration. Provision of the polarising magnetising force avoids the possibility of frequency doubling taking place as a result of similar attractive forces being applied to the specimens by flow of current in the exciting coil in one direction or the other. Providing this precaution is taken the specimens will vibrate at their fundamental frequency since at that frequency damping is least. If a mode of vibration other than the fundamental is required, it is merely necessary to replace filter D by a filter tuned to the frequency of the particular mode of vibration by suitably positioning the pickup device and by such means to induce stresses of the required frequency. The moments exerted by one strip on the clamp 5 by reason of magnetic forces and changes in momentum are equal in magnitude but opposite in direction to those produced by the other strip. For the purpose of this specification, the moments required to secure the end of the strip in the clamp is termed the "fixing moment". It will be appreciated that the fixing moments of the two strips neutralise one another in the clamp 5 and thus substantially no vibration is transmitted to the base board, and as a consequence very little energy is wasted.

The pick-up device 6 may be any arrangement which will control or generate an electric current at the frequency of vibration of the specimens; it may in fact be a contact breaker driven by the specimens. Such apparatus is particularly adapted for testing types of welded or synthetic resin bonded joints in metal to wood structures.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A fatigue testing apparatus wherein two substantially identical specimens of the material under test are mounted side by side in a single mounting and vibrated in opposite phase so that the fixing moments of the specimens are opposite in direction but equal in magnitude.

2. A fatigue testing apparatus as claimed in Claim 1, wherein a single exciter is employed to vibrate the two specimens.

3. A fatigue testing apparatus as claimed in Claim 2, wherein the exciter comprises a set of E-shaped transformer laminations having the exciting coil wound on the centre limb of the E and two further sets of I-shaped laminations,

one disposed perpendicularly at the end of each of the outer limbs of the E, the whole being disposed so that the ends of the I-shaped laminations nearer the centre each act to attract magnetically one of the specimen tips.

4. A fatigue testing apparatus as claimed in Claim 3, wherein the specimens have magnetic tips.

5. A fatigue testing apparatus as claimed in Claim 3, wherein a second winding on the middle limb of the E-shaped laminations serves to polarise the core magnetically.

6. A fatigue testing apparatus as claimed in Claim 3, wherein the core is polarised by means of a permanent magnet.

7. Apparatus for mounting specimens in a fatigue testing apparatus substantially as described with reference to the accompanying drawings.

Dated this 20th day of June, 1947.

For the Applicants:
F. J. CLEVELAND AND COMPANY,
Chartered Patent Agents,
29, Southampton Buildings, Chancery Lane, London, W.C.2.

Printed for His Majesty's Stationery Office by Charles Birchall & Sons, Ltd., Liverpool.—1949.
Code 39-219. Published at the Patent Office, 25, Southampton Buildings, London, W.C.2.
from which copies, price 2s. 0d. each (inland) 2s. 1d. (abroad) may be obtained.

[This Drawing is a reproduction of the Original on a reduced scale.]

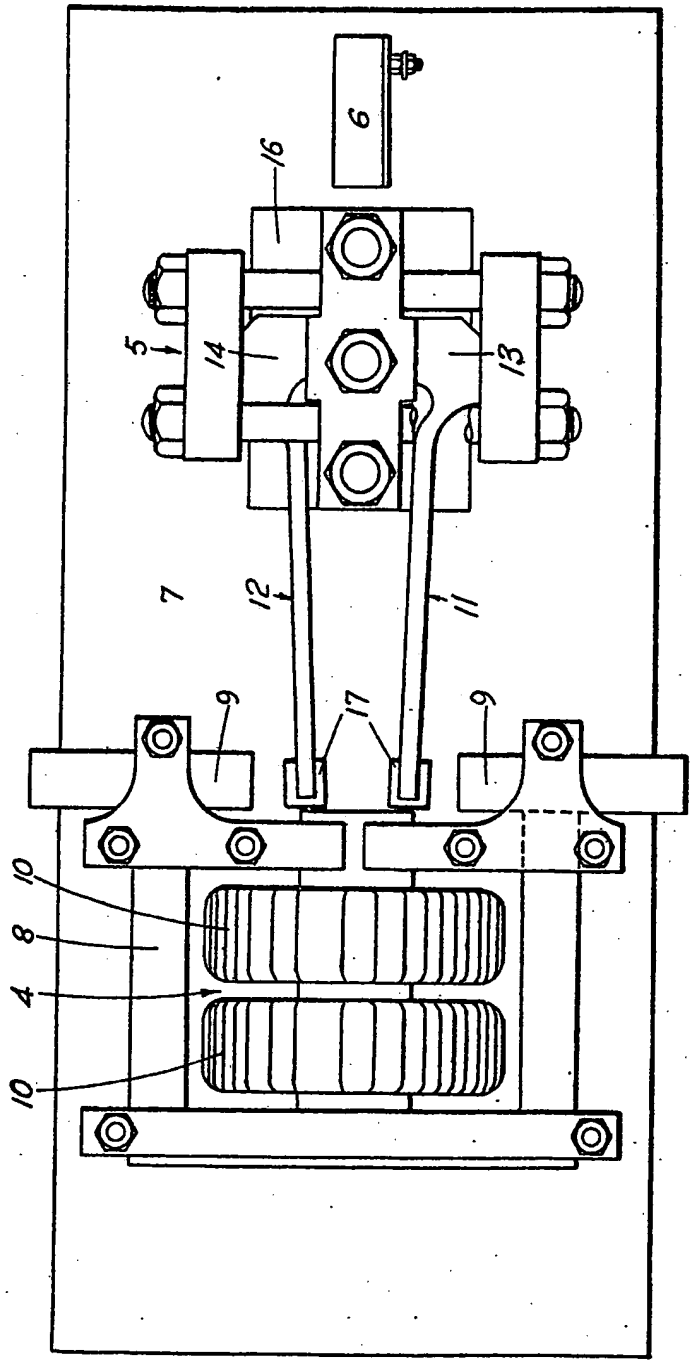
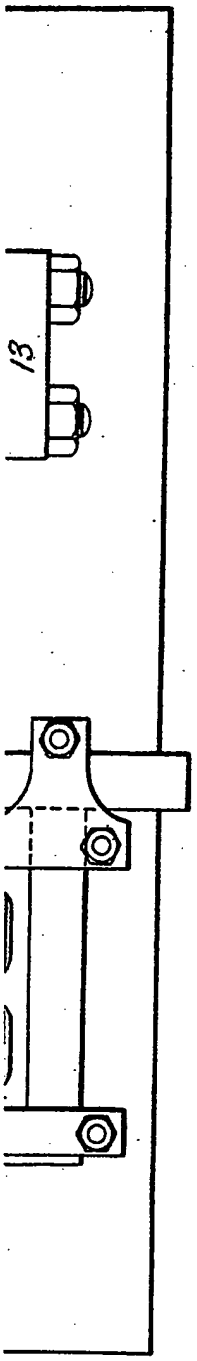


FIG. 1.



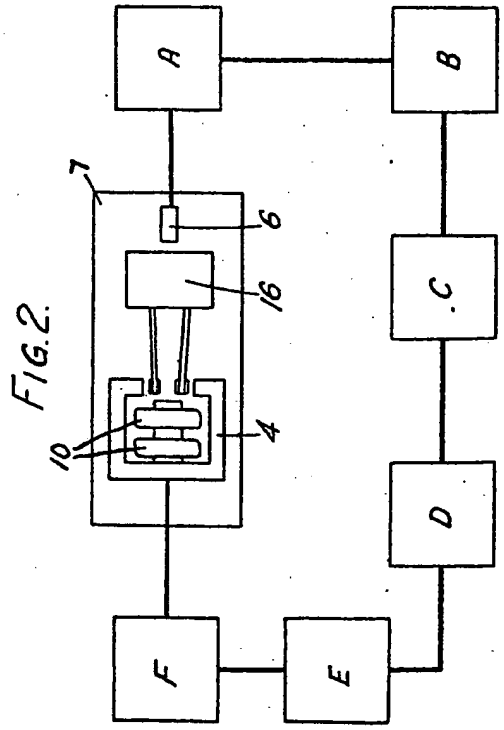


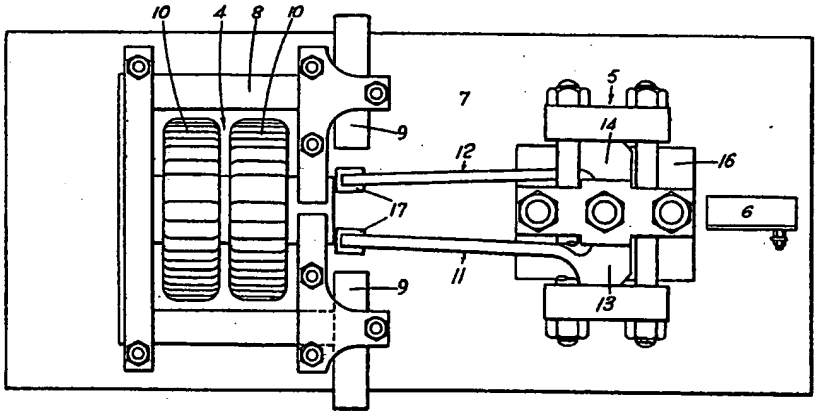
FIG. 2.

H.M.S.O.(Ty.P.)

[This Drawing is a reproduction of the Original on a reduced scale]

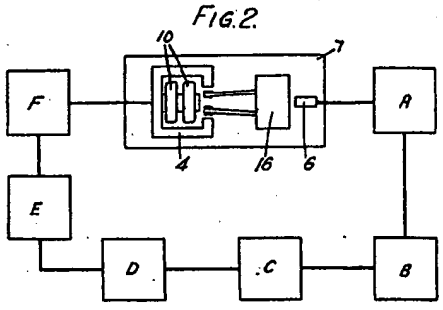
627,501 COMPLETE SPECIFICATION

FIG. 1.



SHEET 1

FIG. 2.



H.M.S.O. (1/-)

3 SHEETS
SHEET 2